



King's Research Portal

DOI:

[10.1016/j.schres.2018.06.040](https://doi.org/10.1016/j.schres.2018.06.040)

Document Version

Peer reviewed version

[Link to publication record in King's Research Portal](#)

Citation for published version (APA):

Edwards, C. J., Cella, M., Emsley, R., Tarrier, N., & Wykes, T. H. M. (2018). Exploring the relationship between the anticipation and experience of pleasure in people with schizophrenia: An experience sampling study. *Schizophrenia Research*. <https://doi.org/10.1016/j.schres.2018.06.040>

Citing this paper

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

General rights

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Exploring the relationship between the anticipation and experience of pleasure in people with schizophrenia: an experience sampling study.

*Clementine J. Edwards*¹, Matteo Cella¹, Richard Emsley², Nicholas Tarrier¹, Til HM Wykes¹.*

¹Department of Psychology, Institute of Psychiatry, Psychology & Neuroscience, Kings College London.

²Department of Biostatistics & Health Informatics, Institute of Psychiatry, Psychology & Neuroscience, King's College London

* corresponding author: Dr. Clementine J. Edwards, Department of Psychology, Institute of Psychiatry, Psychology & Neuroscience, Kings College London, De Crespigny Park, SE5 8AF. Email: clementine.edwards@kcl.ac.uk, Tel: 02078485040, Fax: 02078485006.

Abstract

Background: It has been hypothesised that a reduction in anticipatory pleasure contributes to reduced levels of functioning in people with schizophrenia. Previous research on anticipatory pleasure, however, reports mixed findings and has not yet examined the link between anticipatory pleasure and activity. The aim of this study is to examine how pleasure anticipation is related to difficulties engaging in activity in people with schizophrenia.

Method: A healthy control group (n=44) and a group of individuals with schizophrenia (n=36) completed an experience sampling study using portable devices. Participants rated motivation, mood, functional, leisure and social activity levels; anticipatory and consummatory pleasure seven times a day for six consecutive days. Multi-level regression models were constructed to examine the role of anticipatory pleasure and/or motivation in predicting future activities.

Results: The findings showed no evidence for a motivation or pleasure deficit in people with schizophrenia. Yet, people with schizophrenia did fewer functional activities and spent more time “resting” or “doing nothing”. In the control group, expectation was the only significant predictor of future activity. In contrast, none of the parameters assessed could predict experiences occurring in people with schizophrenia.

Conclusions: In contrast with controls people with schizophrenia did not show a link between their predictions and the activities they engaged in. This appears to be an important process influencing functioning in people with psychosis. Future interventions targeting reduced functioning should focus on reinforcing the link between pleasure anticipation and goal-directed behaviour.

Keywords: negative symptoms, schizophrenia, psychosis, experience sampling methodology, anticipatory pleasure.

1. Introduction

The negative symptoms of schizophrenia have repeatedly been linked to poor functional outcomes and yet there are still no recommended interventions available to clinicians (Foussias et al., 2011; Loas et al., 2009). The Temporal Experience of Pleasure (TEP) model (Kring and Barch, 2014; Kring and Caponigro, 2010) has been influential in the study of these emotional and motivational deficits in schizophrenia (Edwards et al., 2015a). This model proposes a key link between anticipatory pleasure (consisting of both the expectation of future activity and the associated pleasure) and motivation which then drives activity. This hypothesis has attracted a lot of interest in the field as it offers an important potential treatment target to reduce functional difficulties. However, despite extensive research, the findings in the literature to date offer, at best, moderate support for this hypothesis with mixed results regarding anticipatory pleasure deficits in particular (Edwards et al., 2015a).

The majority of studies investigating anticipatory pleasure have been conducted in laboratory settings using tasks and questionnaires in cross-sectional designs. Some show reduced motivation and anticipatory pleasure in people with schizophrenia (Chan et al., 2012; Mote et al., 2014; Reddy et al., 2014; Schlosser et al., 2014) while others have found results in the opposite direction (Strauss et al., 2011). The limitation of these experimental designs is that the stimuli used vary across studies and are often selected according to standardised lists rather than the participant's own preferences. Indeed, the findings from our research demonstrated that the anticipation of pleasure is highly dependent on individual's enjoyment of the stimulus being anticipated (Edwards et al., 2015c). Studies have started to employ experience sampling methodology (ESM) which allows researchers to collect data directly from the participants' everyday lives to reduce a reliance on retrospective memory and maximise ecological validity.

Almost all ESM studies demonstrate similar anticipatory and consummatory pleasure in control and schizophrenia participants, for both social and non-social activities (Brenner

and Ben-Zeev, 2014; Gard et al., 2014; Janssens et al., 2012; McCormick et al., 2012; Oorschot et al., 2013). All ESM studies, however, examined pleasure and motivation as discrete constructs at separate time points. This fails to take full advantage of a key strength of ESM which is the ability to examine patterns and relationships *over time* and the potential to provide information on how anticipation is related to activities. The current study explores the link between anticipatory ratings and specific categories of future events. This approach builds on the existing evidence which suggests that anticipatory pleasure is not globally reduced in people with schizophrenia (Edwards et al., 2015b; Gard et al., 2014; Treméau et al., 2010). Instead, specifically *what is being anticipated* may be important, particularly when considering social activities which are often not studied separately in the literature.

The majority of laboratory studies have examined pleasure ratings in response to stimuli. However, it is important to consider that these ratings occur in an emotional context – the individual's positive and negative affect that they are experiencing at that time. This is particularly important in people with schizophrenia where a phenomena described as 'affective ambivalence' (Treméau et al., 2009) has been observed many times. This refers to simultaneously raised levels of both positive and negative affect in response to both negative and positive events. This has not only been shown in the laboratory but experience sampling studies have found that people with schizophrenia report high levels of negative and positive affect alongside activities they find enjoyable (Oorschot et al., 2013; Sanchez et al., 2014). However, a recent meta-analysis of 12 experience sampling studies found that people with schizophrenia report overall reduced positive affect and increased negative affect when recording their emotion in everyday life (Cho et al., 2016). These findings are not put in the context of the events the person is experiencing and although this pattern may emerge when mood ratings are summarised it may be more relevant to functioning to characterise the moment-to-moment interactions between mood and enjoyment of activities. This relationship was examined in the current moment in an ESM study that reported a weaker link between current enjoyment and negative emotion in people with schizophrenia compared to controls (Sanchez et al., 2014). The current study extends these findings by considering the impact of mood on anticipatory pleasure for *future* activities as well as whether the person then engages in those activities.

The overall aim of this study was to test the hypothesis put forward by the TEP model that anticipatory pleasure, consisting of both an expectation for a future event and the associated pleasure, predicts motivation and influences activity. This study will examine the impact of the emotional context in which events are anticipated by assessing mood and activity enjoyment alongside anticipatory ratings. The findings in people with schizophrenia will be compared with a control group to establish which mechanisms may be disrupted. We expect that people with schizophrenia will show an attenuated link between anticipation and activity.

Our hypotheses from the TEP model and wider research are as follows:

- Anticipatory pleasure, expectation and motivation will be lower in people with schizophrenia compared to control participants.
- Positive and negative affect will be higher in people with schizophrenia compared to controls.
- Functional and social activity levels will be lower in people with schizophrenia compared to control participants. Activity levels will be associated with anticipatory pleasure and expectation in both groups.

2. Method

2.1 Design

This is a comparison study collecting observational data over one week. It includes a group of people with a diagnosis of schizophrenia and a comparison group consisting of people with no history of mental health problems. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The study received ethical approval from London-Harrow NHS Research Ethics Committee (Protocol Ref: 12/LO/1524).

2.2 Sample

Outpatients were recruited from community mental health teams in South London using the following inclusion criteria: (i) DSM-IV diagnosis of schizophrenia, (ii) aged 18-65yrs, (iii) a

score of at least 14 on the negative symptom subscale of the Positive and Negative Symptom Scale (PANSS) (Kay et al., 1988) which ensured negative symptoms were present but allowed for a range of severity (Lysaker and Bell, 1995) (iv) good command of the English language. They were excluded if they had: (i) a DSM-IV diagnosis of substance abuse which may cause substance-induced psychosis, (ii) severe learning difficulties (e.g. diagnosis of a learning disability, severe dyslexia - identified through a medical record review).

Control participants were recruited using online advertisements, community links and word of mouth. Inclusion criteria: (i) no current or history of mental health problems according to the MINI ((Sheehan et al., 1998)) (ii) aged 18-65yrs (iii) good command of the English language.

2.3 Measures

2.3.1 Baseline Clinical and Demographic Characteristics

Symptom severity in the schizophrenia group was assessed with the PANSS (Kay et al., 1988). The five factor solution (Wallwork et al., 2012) is reported following a recent study examining negative symptoms (Cella et al., 2014).

2.3.2 Experience Sampling Questionnaire (See Figure 2 for full questionnaire).

Activity

The experience sampling questionnaire recorded both current and future activity by asking participants to rate their current and future activity categories (i.e. Relaxing, Work/School, Studying, Housekeeping, Shopping, Hygiene, Eating/Drinking, Travelling, Leisure Activity, Nothing).

Mood

Current mood was assessed with the ESM questionnaire by rating 11 feeling states e.g. “Right now I feel [guilty]”. Four of these items were grouped into a positive affect rating and the remaining 7 into a negative affect rating.

Anticipatory and Consummatory Pleasure Ratings

Consummatory and anticipatory pleasure were rated on a 7-point Likert scale from 1 not at all to 7 very much so – “How much are you enjoying this activity?” and “How much do you

think you will enjoy this activity?” The expectation component of anticipatory pleasure was assessed using the item “What do you think are the chances this activity will occur?” rated from 0-100%.

Motivation and Expectation

Motivation was rated using the sum of two items related to the anticipated activity - “How interested are you in this activity?” and “Would you prefer to do something else?” on the same 7-point Likert scale. These questions are posed indirectly because the purpose of the study was to observe not intervene and this style of questioning limits the potential for the participant to change their behaviour in response to the question.

Social Activity and Pleasure Ratings

Socialising was assessed by selecting current and future social contact from 7 categories grouped into familiar (partner, friends, family, colleagues, and acquaintances), unfamiliar (strangers) and nobody. Consummatory and anticipatory pleasure for socialising was rated on the same 7-point Likert scale as other activities.

Preference to be Alone/With Others

A rating of preference to be alone/with others was included and used the same 7-point Likert scale. The questionnaire branched to ensure the participants were asked the appropriate set of questions based on their current company.

----- Figure 2 approximately here -----

2.4 Procedure

The control participants were screened via the telephone by the study researcher prior to attending the initial session. During the initial session participants in the schizophrenia group completed the PANSS. The ESM questionnaires were completed using a PsyMate device (see Figure 3), this is a small portable touchscreen device which represented the best available technology at the time this research was completed (Boyce, 2011; Maastricht University). After the initial session each participant attended a briefing session where they were trained on how to use the device. All participants were asked to carry the device with them for 6 days and were prompted to complete 7 questionnaires per day at

pseudo-random times (at least 45 minutes apart) between 8.30am and 10pm in accordance with standard ESM protocols (Kimhy et al., 2012). At each beep the handheld device presented the participant with the questionnaire to complete within 20 minutes. The study researcher called the participant at two time-points during the data collection week to check on progress and troubleshoot. All items completed were included in the analysis, including any incomplete questionnaires submitted. A 20% minimum threshold of questionnaires completed was set to ensure adequate external validity of the ratings given allowing conclusions to be drawn regarding the wider population. This threshold has been used in previous research (Oorschot et al., 2013) and was found to provide sufficient power in analyses of the reliability of this data reported elsewhere (Edwards et al., 2016). The potential impact of responsivity, where the process of completing the questionnaires affects responses provided by participants, was minimised throughout the design of the procedure and questions used (Edwards et al., 2016).

2.5 Analyses

Demographic information was compared between groups using chi-squared and *t*-test analyses. Number of occasions recorded in different activities and in different company was calculated as a percentage of the total number of beeps completed. These percentages were then compared between groups using one-way ANOVAs. Other variables were not aggregated to produce composite values as this would lose the value of multi-level modelling data and have limited validity as an approach.

Multi-level linear modelling techniques are variations of unilevel linear regression analyses ideally suited to experience sampling data because this creates three levels of analysis (i.e. questionnaire level, day level and participant level). Clustered variation for each time, day and participant is accounted for as random effects in the model; the effects of the predictors on the outcome variable are described as fixed effects. Models can be estimated with continuous or categorical outcomes. The commands XTMIXED for continuous outcome variables and XTMELOGIT for categorical outcome variables in Stata (Version 11.2) (StataCorp, 2009) were used for these analyses (Hartley et al., 2015; Kimhy et al., 2012). Effects from predictors in the multilevel model were expressed as β scores representing the fixed regression coefficient. Interaction variables between the independent variable and group

were entered into all the models to examine whether the effect of the independent variable on the dependent variable was significantly different between groups. Group differences identified in ESM mood variables were entered into future models as covariates.

Time-lagged analyses were conducted using multi-level models; ratings of mood, pleasure and motivation recorded at the previous time-point are entered into the models as predictors of an activity occurring at the next time-point to address the final hypothesis of whether anticipatory pleasure, expectation and motivation predict future activity in both groups.

A power calculation was performed based on a linear multiple regression model with a random factor to give an estimate of sample size. This calculation suggested a total sample of 30 people (15 per group) would be sufficient to detect a population multiple correlation coefficient of 0.4 with up to 8 predictors with an inter-correlation of 0.5 or higher. This sample size is in line with previous research and recommendations in the field e.g. (Kimhy et al., 2012).

3. Results

3.1 Demographics

Five people in the schizophrenia group and 1 in the control group failed to complete >20% of the ESM questionnaires during the week and were excluded from the analyses. There were no differences between those included and excluded in age, medication or symptoms (see Table 1). The final sample included 33 people who completed a total of 951 ESM questionnaires in the schizophrenia group and 43 people in the control group who completed 1,356 ESM questionnaires in total. People with schizophrenia completed 71% of the questionnaires compared to 81% in the control group. There was no significant difference in the completion rates between groups ($X^2=30.17$, $p=.46$). Across the whole sample, 13 incomplete questionnaires were submitted (0.9%). For a detailed analysis of the pattern of completion and the consequences for the validity of the study please refer to Edwards et al. (2016). The groups were balanced for age and gender, but not for ethnicity ($X^2= 7.04$, $p<.05$). People with schizophrenia had lower levels of education and employment than the control group Education: $X^2= 22.72$, $p<.05$; Employment: $X^2= 32.16$, $p<.05$)

-----Table 1 Approximately Here-----

3.2 How Did People Spend Their Time?

People with schizophrenia reported a similar number of leisure activities compared to control participants ($F(66)=.09$, $p=.76$) (see Figure 1). As predicted, control participants reported significantly more functional activities ($F(66)=53.12$, $p<.0001$) and described significantly fewer activities as “nothing” ($F(66)=29.98$, $p<.0001$) or resting ($F(66)=9.84$, $p=.002$).

-----Figure 1 Approximately Here -----

3.3 Who did People Spend Their Time with?

In contrast to our expectations, people with schizophrenia and control participants spent similar amounts of time in both familiar company (SZ 43%, Control participants 49%), unfamiliar company (SZ 2%, Control participants 3%) and alone (SZ 55%, Control participants 48%) ($F(1,75)=.731$, 1.68 , 1.15 respectively, $p=.20-.40$). Due to the very small number of beeps at which the participants indicated they were in the company of strangers these beeps were excluded from further analyses.

3.4 Affective Ambivalence: Emotional Context Predicts Anticipatory Pleasure Ratings in People with Schizophrenia

In line with previous research, negative mood was significantly higher in the schizophrenia group ($\beta= 10.35$ (1.59), $p<.001$), and was therefore controlled in all multi-level

models examining the effect of diagnostic groups (See Table 2). There was no difference in positive mood between groups ($\beta=.22(.98)$, $p=.82$).

-----Table 2 approximately here-----

Consummatory pleasure, negative and positive affect were all associated with anticipatory pleasure in the schizophrenia group (see Appendix 1). This was only the case for positive mood and functional activities in the control group.

3.5 Anticipatory and Consummatory Pleasure in People with Schizophrenia

In contrast to our hypotheses, consummatory pleasure was higher in the schizophrenia group for both leisure and functional activities (see Table 3).

Furthermore, anticipatory pleasure was also significantly higher in the schizophrenia group for both functional and leisure activities. In line with our hypothesis, expectation was lower in the schizophrenia group for functional activities ($\beta= -1.54(.48)$, $p<.001$). However, there were no other significant differences between groups in motivation or expectation.

3.6 What Predicts Non-Social Activities?

To test the hypothesis that anticipatory pleasure, expectation and motivation drive activity, a time-lagged analysis of these variables with activity as the outcome was conducted. In the control group, expectation predicted functional activities ($\beta=.15$, $p=.031$ 95% CI=-.01-.28) occurring at the next time-point (controlling for negative and positive mood). *None* of the time-lagged ratings of anticipatory pleasure, motivation or expectation at a beep predicted the anticipated activity occurring at the next beep in the schizophrenia group.

3.7 Anticipating Time with Others and Alone

There were no significant differences between people with schizophrenia and control participants in anticipatory and consummatory pleasure for social activities ($\beta= .04-.92$, $p>.05$). People with schizophrenia rated a higher preference than control participants to be with others when alone ($\beta=5.62(.47)$, $p<.001$). However, people with schizophrenia also rated

their preference to be alone significantly higher when with other people ($\beta=.84(.23)$, $p<.001$). When alone, people with schizophrenia rated their consummatory pleasure as lower than control participants but at trend level only ($\beta= -.78(.43)$, $p=.07$). None of these variables predicted future social contacts in either group.

4. Discussion

In contrast to expectations, anticipatory pleasure for both leisure and functional activities was significantly higher in people with schizophrenia, replicating findings from two recent studies (Brenner and Ben-Zeev, 2014; Gard et al., 2014). Consummatory pleasure was also found to be higher in the schizophrenia group, in contrast to a previous, smaller, experience sampling study which reported no difference compared to control participants (Gard et al., 2007). However, these elevated pleasure ratings did not translate to expectation and functional activity, both of which were reduced in people with schizophrenia. This group also reported more time “doing nothing” than control participants, despite higher anticipatory pleasure for other activities. These results are in line with a recent study that showed people with schizophrenia spend more time in unstructured activity in comparison to other general population groups (Cella et al., 2016).

Previous research has shown that the emotional context in which anticipation is occurring is important (Edwards et al., 2015c). The findings from this study suggest that the emotional context in which anticipation occurs has a bigger impact in people with schizophrenia compared to control participants as mood ratings were more strongly associated with pleasure and motivation ratings. These mood ratings also differed from controls; negative mood was elevated in people with schizophrenia, replicating a common finding in experience sampling studies (Sanchez et al., 2014). This is in the context of similar levels of positive mood compared to control participants. The presence of high levels of both negative and positive affect is described as “affective ambivalence” (Treméau et al., 2009) and despite its consistent presence in studies the impact of this experience on negative symptoms and functioning is not yet known. The levels of negative affect did not appear to influence future activity in a preliminary analysis in this study so the link with anticipation and expectation may be important.

The findings from the social ratings and activity levels in this study also appear to reflect an ambivalence about spending time with others. People with schizophrenia indicated that they would prefer to change their current social context more than controls – whether that meant being alone or seeking out others. Social behaviour was not driven by motivation as may be predicted by the TEP model. This replicates findings from a recent study which showed that social functioning is associated with social motivation 6 months later but not the other way around (Fulford et al., 2017). This study is further evidence against a linear sequence of motivation and activity, particular in people with schizophrenia. It seems there may be more dynamic and reciprocal relationships between an individual's motivation for an activity and their ability to engage with it.

In the control group, “cognitive” expectation of engaging in an activity predicts this activity occurring more than the anticipated pleasure, for both social and non-social activities. In the TEP model expectation is considered part of anticipatory pleasure whereas these findings suggest it may be an important, distinct component as it is a predictor of future activity whereas anticipatory pleasure is not. Expectation was also significantly *reduced* in people with schizophrenia compared to controls whereas anticipatory pleasure was *higher*. A further aspect to consider is that the construct of expectation is very broad and may incorporate several related constructs e.g. poor planning ability, defeatist beliefs or lack of opportunity which are all absent from the TEP model.

4.1 Limitations and Future Directions

Expectation is an important predictor of activity but this was not measured for social activities in this study. This is a limitation and the role of expectation in engagement in future social activities should be a priority for further research. Cognitive abilities such as executive functions may affect someone's ability to expect and plan for future activity and these were not measured in the study. Future studies should consider assessing for cognitive difficulties as these are likely to be implicated in functioning problems. The inclusion of an eligibility criteria of at least 14 on the PANSS-N ensures the presence of negative symptoms in the sample but limits the heterogeneity and therefore the generalisability to all individuals with a diagnosis of schizophrenia. Replication of these findings in a heterogenous sample would increase the generalisability of these conclusions.

The priority for future research should be to identify the barriers to developing sufficient expectation for completing an activity once it has been anticipated to be enjoyable. Some recent research hypothesised defeatist beliefs (Campellone et al., 2016) and difficulty computing the effort required for the activity (Green et al., 2015) as potential barriers to activity engagement that need to be tested. This study also suggests that interventions which strengthen the link between anticipation and activity may prove useful particularly for those experiencing high levels of negative symptoms. There are several constructs that therapies could target to strengthen this link. For example, the behavioural activation component of cognitive behavioural therapy could incorporate a focus on the decision-making process between anticipation and engaging in an activity (Grant et al., 2012). Cognitive remediation was found to have a moderate positive effect on negative symptoms (Cella et al, 2016). Elements of this intervention could be further tailored to maximise its impact on potential cognitive domains that may be relevant to negative symptoms. Examples of possible mechanisms that cognitive remediation can target and are relevant for negative symptoms are reward learning (Cella et al., 2013), executive functions and planning (Farreny et al., 2013).

The results of this study indicate that identifying pleasurable activities and enjoying them is not a problem for people with schizophrenia. The issue perpetuating functional difficulties is likely to be expectation and the link this forms between anticipation and activity.

References

- Boyce, N., 2011. The Lancet Technology: August, 2011. *The Lancet* 378(9790), 475.
- Brenner, C.J., Ben-Zeev, D., 2014. Affective forecasting in schizophrenia: comparing predictions to real-time Ecological Momentary Assessment (EMA) ratings. *Psychiatric rehabilitation journal* 37(4), 316-320.
- Campellone, T.R., Sanchez, A.H., Kring, A.M., 2016. Defeatist Performance Beliefs, Negative Symptoms, and Functional Outcome in Schizophrenia: A Meta-analytic Review. *Schizophrenia bulletin*.
- Cella, M., Bishara, A.J., Medin, E., Swan, S., Reeder, C., Wykes, T., 2013. Identifying Cognitive Remediation Change Through Computational Modelling--Effects on Reinforcement Learning in Schizophrenia. *Schizophr Bull*.
- Cella, M., Edwards, C.J., Wykes, T.H.M., 2016. A question of time: A study of time use in people with schizophrenia. *Schizophr. Res*.
- Chan, R.C., Shi, Y.F., Lai, M.K., Wang, Y.N., Wang, Y., Kring, A.M., 2012. The Temporal Experience of Pleasure Scale (TEPS): exploration and confirmation of factor structure in a healthy Chinese sample. *PLoS One* 7(4), e35352.

Cho, H., Gonzalez, R., Lavaysse, L.M., Pence, S., Fulford, D., Gard, D.E., 2016. Do people with schizophrenia experience more negative emotion and less positive emotion in their daily lives? A meta-analysis of experience sampling studies. *Schizophrenia research*.

Edwards, C.J., Cella, M., Tarrier, N., Wykes, T., 2015a. Investigating the empirical support for therapeutic targets proposed by the temporal experience of pleasure model in schizophrenia: A systematic review. *Schizophr Res* 168(1-2), 120-144.

Edwards, C.J., Cella, M., Tarrier, N., Wykes, T., 2015b. Investigating the empirical support for therapeutic targets proposed by the temporal experience of pleasure model in schizophrenia: A systematic review. *Schizophr. Res.* 168(1), 120-144.

Edwards, C.J., Cella, M., Tarrier, N., Wykes, T., 2015c. Predicting the future in schizophrenia: The discrepancy between anticipatory and consummatory pleasure. *Psychiatry Res* 229(1-2), 462-469.

Edwards, C.J., Cella, M., Tarrier, N., Wykes, T.H.M., 2016. The Optimisation of Experience Sampling Protocols in People with Schizophrenia. *Psychiatry Research* 244, 289-293.

Farreny, A., Aguado, J., Ochoa, S., Haro, J.M., Usall, J., 2013. The role of negative symptoms in the context of cognitive remediation for schizophrenia. *Schizophrenia research* 150(1), 58-63.

Foussias, G., Mann, S., Zakzanis, K.K., van Reekum, R., Agid, O., Remington, G., 2011. Prediction of longitudinal functional outcomes in schizophrenia: the impact of baseline motivational deficits. *Schizophrenia research* 132(1), 24-27. Epub 2011 Jul 2019.

Fulford, D., Piskulic, D., Addington, J., Kane, J.M., Schooler, N.R., Mueser, K.T., 2017. Prospective Relationships Between Motivation and Functioning in Recovery After a First Episode of Schizophrenia. *Schizophrenia Bulletin*.

Gard, Kring, Gard, Horan, Green, 2007. Anhedonia in schizophrenia: distinctions between anticipatory and consummatory pleasure. *Schizophrenia research* 93(1-3), 253-260. Epub 2007 May 2009.

Gard, D.E., Sanchez, A.H., Cooper, K., Fisher, M., Garrett, C., Vinogradov, S., 2014. Do people with schizophrenia have difficulty anticipating pleasure, engaging in effortful behavior, or both? *J Abnorm Psychol* 123(4), 771-782.

Grant, P.M., Huh, G.A., Perivoliotis, D., Stolar, N.M., Beck, A.T., 2012. Randomized trial to evaluate the efficacy of cognitive therapy for low-functioning patients with schizophrenia. *Arch Gen Psychiatry.* 69(2), 121-127. doi: 110.1001/archgenpsychiatry.2011.1129. Epub 2011 Oct 1003.

Green, M.F., Horan, W.P., Barch, D.M., Gold, J.M., 2015. Effort-Based Decision Making: A Novel Approach for Assessing Motivation in Schizophrenia. *Schizophrenia bulletin* 41(5), 1035-1044.

Hartley, S., Haddock, G., Vasconcelos, E.S.D., Emsley, R., Barrowclough, C., 2015. The influence of thought control on the experience of persecutory delusions and auditory hallucinations in daily life. *Behaviour research and therapy* 65, 1-4.

Janssens, M., Lataster, T., Simons, C.J.P., Oorschot, M., Lardinois, M., van Os, J., Myin-Germeyns, I., 2012. Emotion recognition in psychosis: No evidence for an association with real world social functioning. *Schizophrenia Research* 142(1-3), 116-121.

Kimhy, D., Myin-Germeyns, I., Palmier-Claus, J., Swendsen, J., 2012. Mobile assessment guide for research in schizophrenia and severe mental disorders. *Schizophrenia bulletin* 38(3), 386-395.

Kring, Barch, D.M., 2014. The motivation and pleasure dimension of negative symptoms: Neural substrates and behavioral outputs. *European Neuropsychopharmacology* 24(5), 725-736.

Kring, Caponigro, 2010. Emotion in Schizophrenia Where Feeling Meets Thinking. *Current directions in psychological science* 19(4), 255-259.

Loas, G., Azi, A., Noisette, C., Legrand, A., Yon, V., 2009. Fourteen-year prospective follow-up study of positive and negative symptoms in chronic schizophrenic patients dying from suicide compared to other causes of death. *Psychopathology* 42(3), 185-189. Epub 2009 Mar 2027.

Maastricht University, PsyMate: Insight into Daily Moods

McCormick, B.P., Snethen, G., Lysaker, P.H., 2012. Emotional episodes in the everyday lives of people with schizophrenia: the role of intrinsic motivation and negative symptoms. *Schizophr Res* 142(1-3), 46-51.

Mote, J., Minzenberg, M.J., Carter, C.S., Kring, A.M., 2014. Deficits in anticipatory but not consummatory pleasure in people with recent-onset schizophrenia spectrum disorders. *Schizophrenia research* 159(1), 76-79.

Oorschot, M., Lataster, T., Thewissen, V., Lardinois, M., Wichers, M., van Os, J., Delespaul, P., Myin-Germeys, I., 2013. Emotional Experience in Negative Symptoms of Schizophrenia--No Evidence for a Generalized Hedonic Deficit. *Schizophrenia Bulletin* 20, 20.

Reddy, F.L., Green, M.F., Rizzo, S., Sugar, C.A., Blanchard, J.J., Gur, R.E., Kring, A.M., Horan, W.P., 2014. Behavioral approach and avoidance in schizophrenia: An evaluation of motivational profiles. *Schizophr. Res.*(0).

Sanchez, A.H., Lavaysse, L.M., Starr, J.N., Gard, D.E., 2014. Daily life evidence of environment-incongruent emotion in schizophrenia. *Psychiatry Res* 220(1-2), 89-95.

Schlosser, D.A., Fisher, M., Gard, D., Fulford, D., Loewy, R.L., Vinogradov, S., 2014. Motivational deficits in individuals at-risk for psychosis and across the course of schizophrenia. *Schizophrenia research*.

Sheehan, D.V., Lecrubier, Y., Sheehan, K.H., Amorim, P., Janavs, J., Weiller, E., Hergueta, T., Baker, R., Dunbar, G.C., 1998. The Mini-International Neuropsychiatric Interview (MINI): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of clinical psychiatry* 59, 22-33.

StataCorp, 2009. Stata Statistical Software: Release 11. StataCorp LP, College Station, TX.

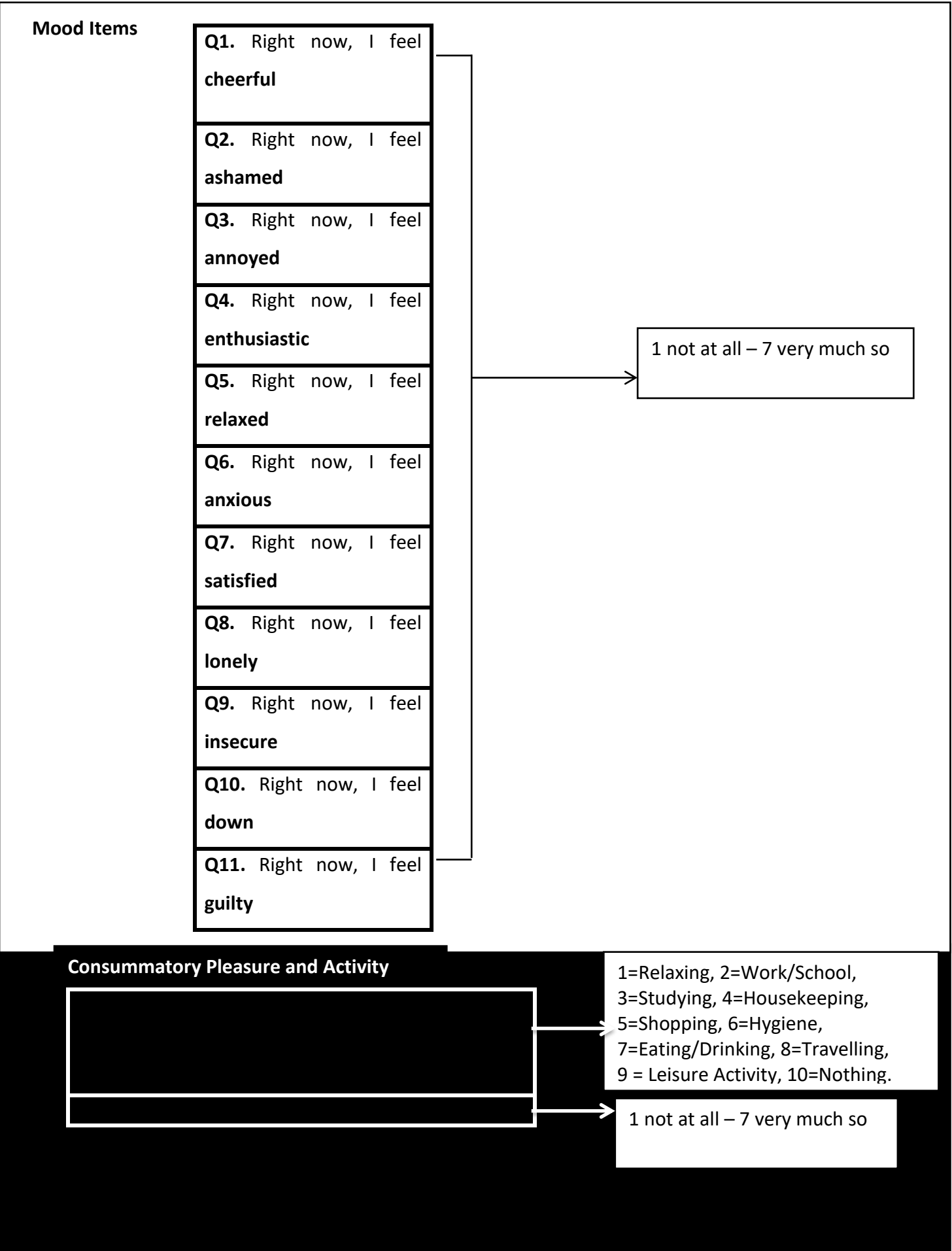
Strauss, G.P., Wilbur, R.C., Warren, K.R., August, S.M., Gold, J.M., 2011. Anticipatory vs. consummatory pleasure: what is the nature of hedonic deficits in schizophrenia? *Psychiatry Research* 187(1-2), 36-41. Epub 2011 Feb 2015.

Treméau, F., Antonius, D., Cacioppo, J.T., Ziwich, R., Butler, P., Malaspina, D., Javitt, D.C., 2010. Anticipated, on-line and remembered positive experience in schizophrenia. *Schizophrenia research* 122(1-3), 199-205. Epub 2009 Nov 2010.

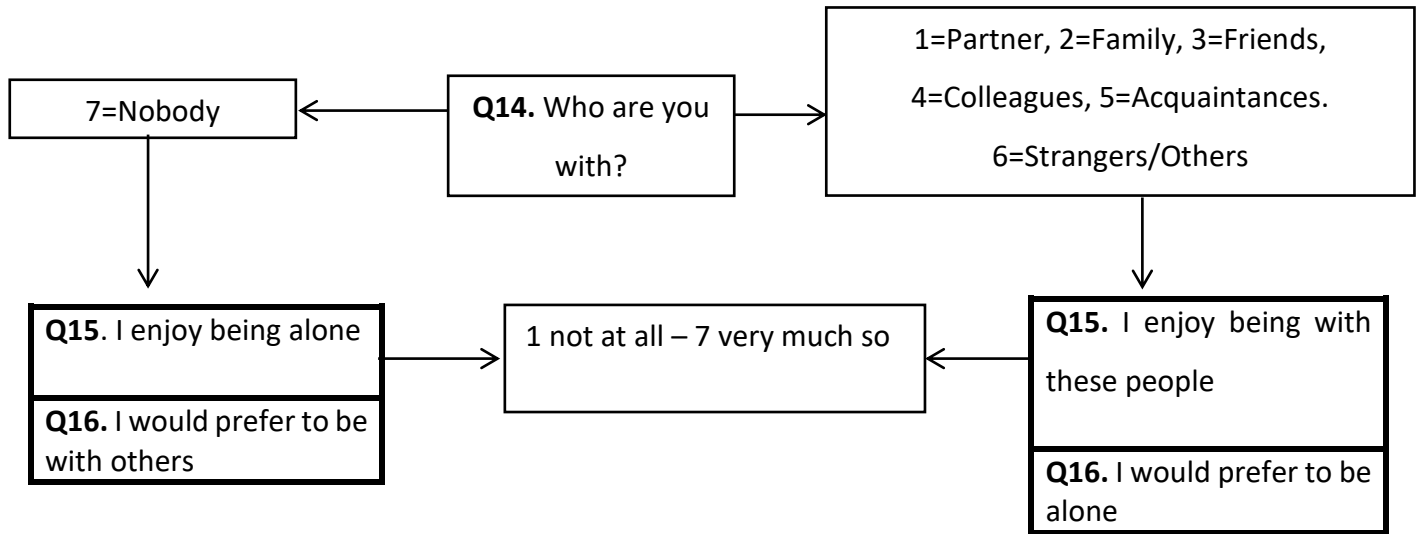
Treméau, F., Antonius, D., Cacioppo, J.T., Ziwich, R., Jalbrzikowski, M., Saccente, E., Silipo, G., Butler, P., Javitt, D., 2009. In support of Bleuler: objective evidence for increased affective ambivalence in schizophrenia based upon evocative testing. *Schizophr Res.* 107(2-3), 223-231. Epub 2008 Oct 2022.

Wallwork, R.S., Fortgang, R., Hashimoto, R., Weinberger, D.R., Dickinson, D., 2012. Searching for a consensus five-factor model of the Positive and Negative Syndrome Scale for schizophrenia. *Schizophr Res* 137(1-3), 246-250.

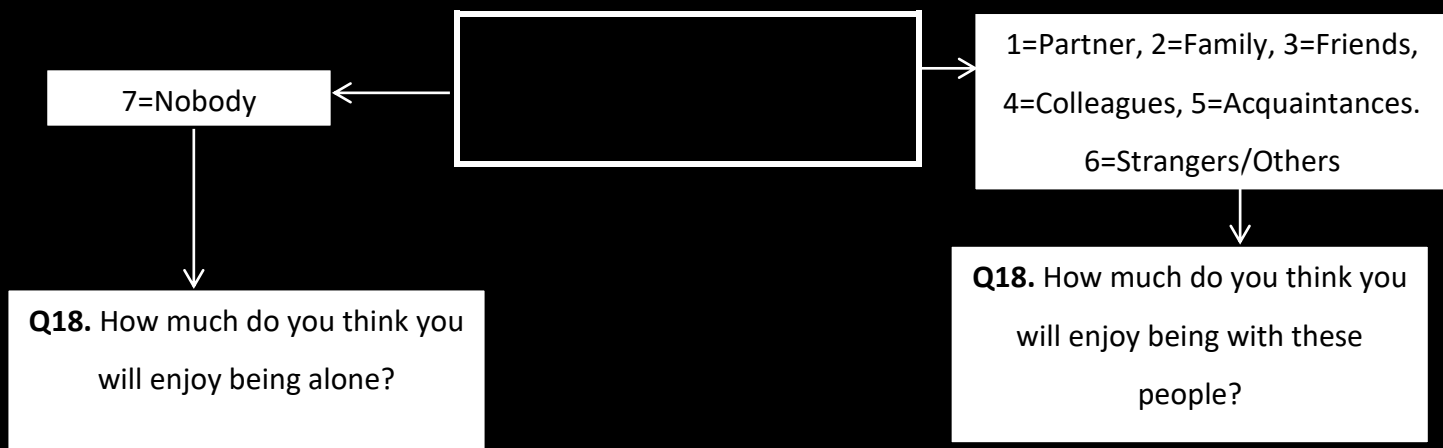
Figure 1: ESM questionnaire: items and branching



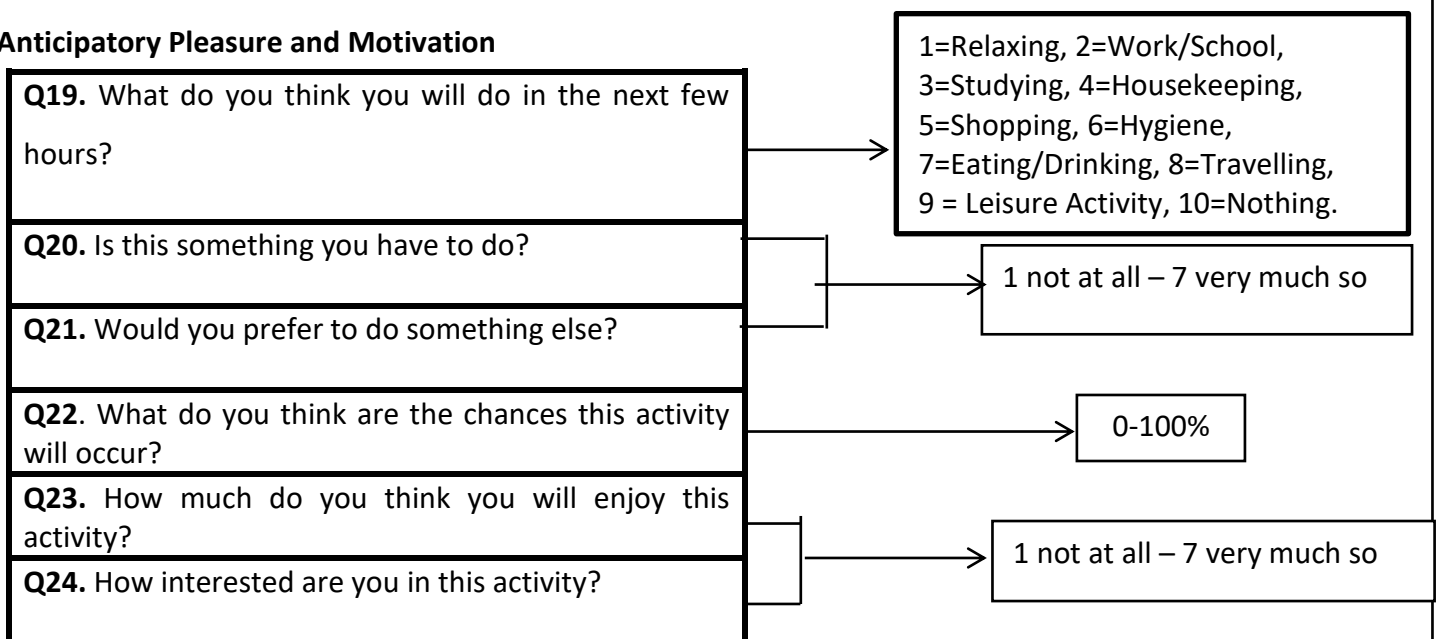
Social Consummatory Pleasure



Social Anticipatory Pleasure



Anticipatory Pleasure and Motivation



Demographics	SZ (n=33)	HC (n=43)
Age	42.27 (8.85)	39.56 (10.70)
Gender (% Male)	75.8%	69.8%
Ethnicity*	White = 33.3% Black = 63.6% Asian = 3.1%	White = 51.2% Black = 43.9% Asian = 13.9%
Education*	SS = 42.4% FE = 39.4% HE = 18.2%	SS = 9.3% FE = 18.6% HE = 72.1%
Employment (% Unemployed)*	91%	30%
Mean Chlorpromazine Equivalent Dosage (SD)	381.64 (362.72)	
PANSS Negative Mean (SD)	17.85 (4.24)	
PANSS Disorganised Mean (SD)	6.21 (2.12)	
PANSS Depressed Mean (SD)	7.10 (2.78)	
PANSS Positive Mean (SD)	8.88 (4.66)	
PANSS Excited Mean (SD)	5.03 (1.26)	

SS= secondary school, FE = further education (16-18yrs), HE= higher education (18yrs+). * = significant difference between groups.

Table 1: Sample Characteristics

Figure 2: Proportion of time-points selected in each activity across the whole ESM week

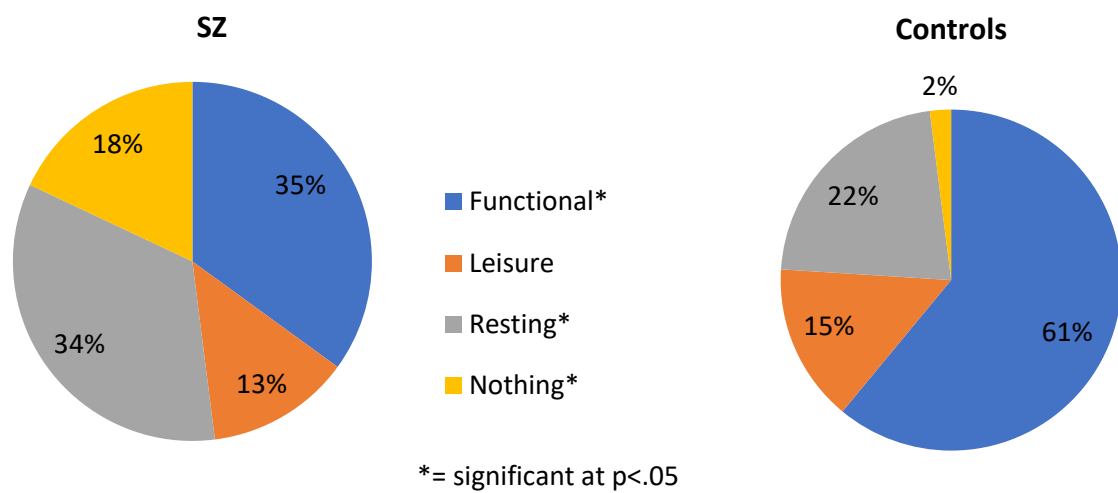


Figure 3: PsyMate



<i>Multi-Level Model</i> (N=2287 beeps)	<i>Outcome Variable</i>	<i>Predictors</i>	<i>Beta Coefficient (SD)</i>	<i>95% Confidence Intervals</i> (Beta Coefficient)	<i>P Value</i>
<i>Model 1</i>	Negative Mood	Group	10.35 (1.59)	7.23-13.45	.0001
		Positive Mood	-.27 (.07)	-.41- -.12	.0001
		Positive Mood x Group	-.03 (.05)	-.13-.06	.49
		Intercept	4.81 (2.41)	.09-9.52	.05
<i>Model 2</i>	Positive Mood	Group	.22 (.98)	-1.70-2.14	.82
		Negative Mood	-.55 (.06)	-.68- -.43	.0001
		Negative Mood x Group	.19 (.04)	.12-.26	.0001
		Intercept	20.85 (1.46)	17.99-23.72	.0001
<i>Multi-Level Model</i> (N=2287 beeps)	Outcome Variable	Predictors	Beta Coefficient (SD)	95% Confidence Intervals (Beta Coefficient)	P Value
<i>Model 1</i>	Negative Mood	Group	10.35 (1.59)	7.23-13.45	.0001
		Positive Mood	-.27 (.07)	-.41- -.12	.0001
		Positive Mood x Group	-.03 (.05)	-.13-.06	.49
		Intercept	4.81 (2.41)	.09-9.52	.05
<i>Model 2</i>	Positive Mood	Group	.22 (.98)	-1.70-2.14	.82
		Negative Mood	-.55 (.06)	-.68- -.43	.0001
		Negative Mood x Group	.19 (.04)	.12-.26	.0001
		Intercept	20.85 (1.46)	17.99-23.72	.0001

Table 2: Multi-level models of between-group differences in positive and negative affect

Multi-Level Model (n = beeps)	Outcome Variable	Predictors	Beta Coefficient (SD)	95% Confidence Intervals (Beta Coefficient)	P Value
SZ Group Leisure (n=45)	Anticipatory Pleasure	Consummatory Pleasure	.70 (.15)	.41-.99	.0001
		Negative Mood	.06 (.02)	.01-.10	.02
		Positive Mood	.11 (.05)	.01-.20	.03
		Intercept	-1.18 (1.29)	-3.71-1.34	.36
Control Group Leisure (n=93)	Anticipatory Pleasure	Consummatory Pleasure	.17 (.11)	-.04-.37	.11
		Negative Mood	-.05 (.04)	-.13-.02	.18
		Positive Mood	.03(.03)	-.03-.09	.29
		Intercept	4.54 (.82)	2.93-6.15	.0001
SZ Group Functional (n=188)	Anticipatory Pleasure	Consummatory Pleasure	.48 (.06)	.36-.60	.0001
		Negative Mood	-.04(.01)	-.06 -.02	.001
		Positive Mood	.05(.02)	.01-.09	.005
		Intercept	2.58 (.54)	1.53-3.64	.0001
Control Group Functional (n=550)	Anticipatory Pleasure	Consummatory Pleasure	.18 (.05)	.09-.27	.0001
		Negative Mood	-.003 (.01)	-.03-.02	.81
		Positive Mood	.08 (.02)	.05-.11	.0001
		Intercept	2.54 (.32)	1.92-3.16	.0001
SZ Group Leisure (n=45)	Expectation	Consummatory Pleasure	-.30 (.22)	-.72-.13	.18
		Anticipatory Pleasure	-.05(.17)	-.39-.28	.75
		Negative Mood	-.09(.03)	-.15 -.03	.005
		Positive Mood	-.0003 (.05)	-.10-.10	.99
		Intercept	13.91 (1.61)	10.75-17.06	.0001
Control Group Leisure (n=93)	Expectation	Consummatory Pleasure	-.05 (.10)	-.25-.16	.66
		Anticipatory Pleasure	.01 (.09)	-.17-.20	.88
		Negative Mood	-.02 (.04)	-.10-.06	.65
		Positive Mood	.06 (.03)	.001-.12	.04

<i>SZ Group Functional (n=188)</i>	Expectation	Intercept	10.15 (.95)	8.29-12.02	.0001
		Consummatory Pleasure	0.13 (.11)	-.35-.08	.22
		Anticipatory Pleasure	.17 (.11)	-.05-.39	.12
		Negative Mood	-.10 (.02)	-.14- -.06	.0001
		Positive Mood	.09 (.03)	.03-.16	.003
		Intercept	9.37 (1.12)	7.17-11.57	.0001
<i>Control Group Functional (n=550)</i>	Expectation	Consummatory Pleasure	.05 (.07)	-.10-.19	.53
		Anticipatory Pleasure	.18 (.07)	.05-.32	.008
		Negative Mood	.03 (.02)	-.01-.01	.12
		Positive Mood	.02 (.03)	-.03-.07	.48
		Intercept	9.23 (.57)	8.12-10.35	.0001

Table 3: Multi-level Models of the Associations between Current Mood, Enjoyment and Anticipatory Pleasure and Expectation

<i>Multi-Level Model</i>	<i>Outcome Variable</i>	<i>Predictors</i>	<i>Beta Coefficient (SD)</i>	<i>95% Confidence Intervals (Beta Coefficient)</i>	<i>P Value</i>
<i>Model 3 (n=327)</i>	Leisure Consummatory Pleasure	Group	.98 (.41)	.02	.18-1.78
		Negative Mood	-.08 (.05)	.09	-.18-.01
		Negative Mood x Group	.001 (.03)	.97	-.05-.05
		Intercept	5.33 (.61)	.0001	4.14-6.52
<i>Model 4 (n=1158)</i>	Functional Consummatory Pleasure	Group	.60 (.34)	.08	-.07-1.26
		Negative Mood	-.18 (.03)	.0001	-.24- -.13
		Negative Mood x Group	.07 (.02)	.0001	.03-.10
		Intercept	5.13 (.48)	.0001	4.20-6.06
<i>Model 5 (n=389)</i>	Leisure Anticipatory Pleasure	Group	.61 (.15)	.0001	.31-.91
		Negative Mood	.03 (.03)	.23	-.02-.09
		Average Consummatory Pleasure	.61 (.15)	.0001	.31-.91
		Group x Average Consummatory Pleasure x Negative Mood.	-.01 (.002)	.01	-.01- -.002
		Intercept	1.14 (1.08)	.29	-.98-3.26
<i>Model 6 (n=1173)</i>	Functional Anticipatory Pleasure	Group	.59 (.19)	.002	.21-.97
		Negative Mood	-.04 (.02)	.02	-.07- -.01
		Average Consummatory Pleasure	.81 (.08)	.0001	.65-.97
		Intercept	1.14 (1.08)	.29	-.98-3.26

Table 4: Multi-level models of between-group differences in consummatory pleasure, anticipatory pleasure, expectation and motivation